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State Estimation for the Automotive SCR Process

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Abstract: Selective catalytic reduction (SCR) of NO_x is a widely applied diesel engine exhaust gas aftertreatment technology. For advanced SCR process control, like model predictive control, full state information of the process is required. The ammonia coverage ratio inside the catalyst is difficult to measure. Therefore we design an ordinary Kalman filter as well as an extended Kalman filter to estimate the ammonia coverage. The filters are built over a first principle model with four states. Among the four states, NO, NO_2 and NH_3 concentration are measured by the sensors, while the ammonia coverage ratio is left to be unknown. The performance of the filters is shown by simulation with the World Harmonized transient cycle. In particular, during transient operations the extended Kalman filter performs significantly better than the ordinary Kalman filter. Since such operation regimes are always present for SCR in engine applications, we recommend to estimating the ammonia coverage using the extended Kalman filter.

Keywords: Kalman filter, Extended Kalman filter, Selective catalytic reduction